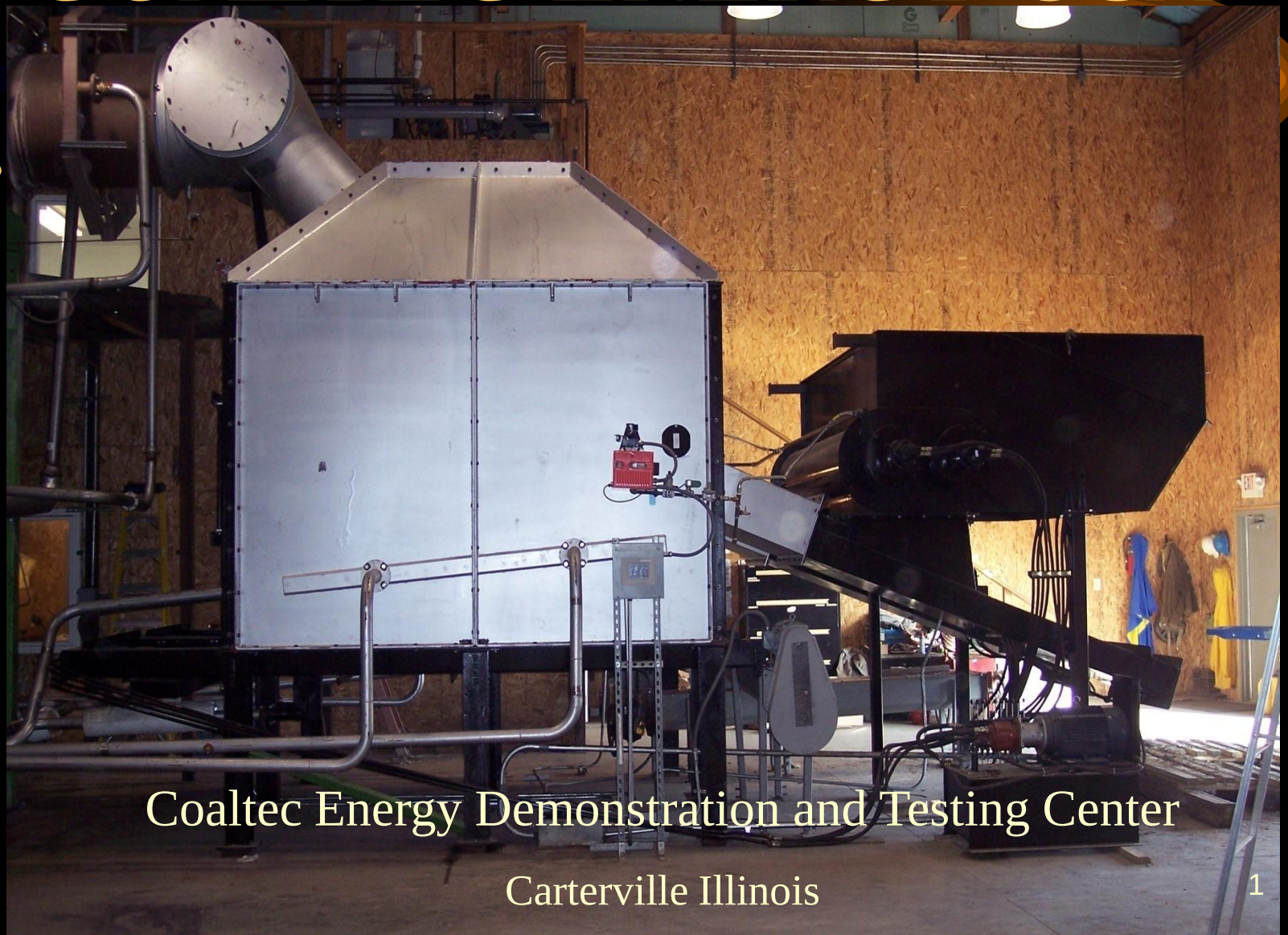
COALTEC ENERGY USA



Coaltec Energy Demonstration and Testing Center

Carterville Illinois

COALTEC ENERGY USA TECHNOLOGY

- Fixed-bed gasifier
- Oxygen-starved environment controls NOx formation
- Low pressure system with minimal carryover of particulate matter
- Proper retention time - reaction of carbon gases
- Ability to control volume of residual carbon in the ash to produce valuable BIOCHAR

COALTEC ENERGY USA TECHNOLOGY

- Main product of gasification is syngas
- Primarily CO with some hydrogen gas and methane
- Syngas is typically around 1200 degrees F.
- Syngas transitions into the oxidizer
- Introduction of additional air causes combustion - CO is converted to CO_2
- Final product 1800-2000 degrees F. heat stream

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- Coaltec's demonstration facility developed to test new fuels, or combinations of fuels, at a commercial scale
- Modular design facilitates combining other technologies and equipment with the basic gasification unit
- Add auxiliary equipment to use the energy product as direct heat, chilling, steam, electricity

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AGRICULTURAL APPLICATION

- While Coaltec is developing projects in many sectors, agriculture offers the most exciting opportunities.
- Most other technologies are limited to fuels such as wood – manure presents some unique challenges.
- But, it also presents some unique benefits as well.

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AGRICULTURAL APPLICATION

- Multiple benefits from system
- Sized to needs of each operation – or cluster of operations.
- Easy to operate and maintain
- Offsite remote operation available
- Minimal material handling
- No long-distance manure transportation costs

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AGRICULTURAL APPLICATION

Energy available for many applications to benefit host site:

- Direct heat to provide hot water for process use
- Heat to supply absorption chiller for cool water or air to increase animal comfort; also for chilling milk tanks
- Building heat and cooling
- Heat for drum dryer to dry high-moisture manure into pathogen-free commodity or for additional fuel
- Steam
- Power

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AGRICULTURAL APPLICATION

- System consumes large volumes of manure
  - Smallest system will process up to 1500 pounds per hour; with some planned projects up to 6 tons per hour.
- Air emissions comply with regulatory standards
  - NOx levels are extremely low
- Dry solid ash typically 15% - 30% of original
  - Many of salt compounds volatilized or altered during gasification process
  - Contains nutrients in an easily handled and transported form
  - Valuable BIOCHAR ash has unique ability to sequester carbon and provide benefits as either a soil amendment, feed supplement, or water filtration medium.

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BIOCHAR

BIOCHAR – the environmental buzzword

- Engineered byproduct of gasification process
- Sequesters carbon in the soil for hundreds, even thousands, of years – Terra Preta
- Improves soil fertility thereby stimulating plant growth which then consumes more CO2 from the atmosphere
- Project economic stabilizer

- www.Biochar-International.org

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BIOCHAR

- The key to any biomass project is the ability to generate multiple revenue streams.
- The ash, or BIOCHAR, has always been a component of the economics for agricultural projects.
- However, the potential value of BIOCHAR has totally changed the economics of these projects.

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BIOCHAR

- Historically, most BIOCHAR has been the product of wood gasification
- The use of manures as the fuel will reduce the carbon content, but it adds vital nutrients (P and K) in the char
- Research has shown that the nutrient uptake in the crops is increased, so less nutrients are required, and there is less chance of run off

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BIOCHAR

Multiple Revenue Streams - Key to Economic Viability

BIOCHAR –

- Ash product from gasification provides an excellent nutrient base – nutrient concentrated, pathogen-free, easily transported and handled
- Add value of carbon char in an engineered BIOCHAR product and the value increases dramatically
- Actual value is uncertain; could easily exceed value of commercial fertilizer
- Other known uses include water and air filtration medium with significant value, and in some cases it can be used as a feed additive

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Multiple Revenue Streams - Key to Economic Viability

- Cost avoidance for manure handling and removal – a cost and environmental issue
- Ability to increase farm size – improved manure management system will allow potential expansion
- Animal comfort – heating and cooling of animals will increase production. This revenue stream is much greater than other uses for the energy – including power production
- Soil and water quality – depletion of soils and/or soil and water pollution eventually becomes an economic issue

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Multiple Revenue Streams - Key to Economic Viability

- Variety of energy applications
- Nutrient credits and carbon credits

The key to agricultural projects is the recognition that except in rare cases, the energy sales will not justify the project. This fact has made it difficult to finance projects as most funders do not understand these projects and only look for traditional revenue streams such as tipping fees and power purchase agreements.

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One of the greatest challenges facing the development of projects is the establishment of markets for nutrient credits, biochar, and other alternative sources of revenue.

The education of people to their benefits, and thus their value will take time and has just started.

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- Coaltec has two systems on operational farms.
- These systems are modular and easily and quickly installed.

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Day One of Installation at Turkey Facility in MN